Midwest Engineer

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ENGINEERING MANPOWER SHORTAGE—PAGE 11

WSE MEETINGS, PAGE 4

WESTERN SOCIETY OF ENGINEERS FOUNDED 1869

Vol. 4 OCTOBER 1951 No. 2

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Serving the Engineering Profession

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COVER LEGEND

Henry Townley Heald, Past President of WSE, who leaves the Presidency of IIT to become Chancellor of New York University. See Editor's Page (3).

Reserve Every Wednesday

Yes... WEDNESDAYS this year...

for

NOON LUNCHEON MEETINGS

FROM 12:00 TO 1:15 SHARP, WSE DINING ROOM

NO RESERVATION REQUIRED

HEAR THESE INTERESTING SPEAKERS:

Oct. 17 **Speaker—Dr. Frederic T. Jung**
Subject —"Repair and Replacement in the Human Machine."

Oct. 24 **Speaker—Leo Fischer, Sports Editor, Herald American**
Subject —"Current Collegiate Football."

Oct. 31 **Speaker—Lieut. Joe Healy of the Narcotics Court, Chicago Police Department**
Subject —"The Narcotics Evil."

Nov. 7 **Speaker—Arthur W. Howson (Trustee, WSE)**
Subject —"Hawaii and the Pacific Islands."

Remember... Every Wednesday... Noon Luncheon Meetings

"NOBODY IS INTERESTED IN ME"

The above statement made by Henry T. Heald in 1944 epitomizes the character of a man in whom we are all definitely interested.

Henry Townley Heald, past president and member of the Western Society of Engineers since 1930, in moving on to greater heights leaves behind an astonished yet loyal legion of friends, and associates—ardent admirers all—of his sincerity, devotion, and ability.

We would be tempted to say his middle initial, T, stood for *transcontinental,* if we did not know better, because with his acceptance of the Chancellorship of New York University his career will have traversed the American Continent.

Starting his professional career on the Pacific Coast, in 1930 he came east to Chicago, the colossus of the Middle West, and in doing so became a colossus himself in the life and welfare of the community. This he became not so much by design as by acclaim because of his devotion to the cause of education and industry.

Henry T. Heald has been an institution in Chicago—his influence felt in all walks of life and particularly in all constructive improvements. Illinois Institute of Technology, the institution to which he brought fame by his capacity for leadership and coordination, has become recognized as the largest institution of its kind in America.

Many will remember his arrival on the campus at Armour Institute of Technology and the initial stages of his taking hold there and ultimately enlarging both the institution's physical size and its prestige. His having accomplished so much with so little is a tribute to his astute judgment in aligning himself with and seeking advice from such leaders of engineering and industry as the Kahlers, the Cunninghams, the Baileys, the Slezaks, the Skogs, and many others. Their help was solicited and secured because they *were interested in Henry T. Heald,* and what he desired to accomplish.

The average citizen thinks of Henry T. Heald as a civic leader—college president—champion of the underprivileged. The engineer knows that Mr. Heald is first and foremost an engineer and the champion of the cause of engineers. All engineers are aware of his unceasing efforts to elevate the profession and to effect proper utilization of technical manpower in our country. In 1944 Henry T. Heald warned that the indiscriminate draining and improper allocation of engineering manpower by the Army would bring a post-war crisis. Today we are struggling with that very crisis.

Henry T. Heald has been an institution in Chicago—his influence felt in all constructive improvements. His moving out to greater horizons is lamented, yet we cannot, if we be unselfish, but know that he is not a regional but a national figure. Solace and pleasure will be taken by his many friends in the Middle West in knowing that we shall have, more than ever, a champion of the engineering profession. We shall watch his progress toward his determined goal with pride. God Speed you, Henry, and remember everyone here in the Middle West and particularly those of us in WSE *are interested in you.*

October 15, Truck Terminals for Chicago

SPONSORED BY THE TRANSPORTATION ENGINEERING SECTION

Mr. Harry F. Chaddick, Chairman of the Committee on Motor Truck Terminals of the City of Chicago, Past President of the Central Freight Association, a member of the National Defense Transportation Committee, and at present actively engaged in the trucking business, will speak on the subject of Truck Terminals in the City of Chicago.

Mr. Chaddick will discuss the need for improvement in the trucking terminal situation; on the consolidation and regrouping of the existing terminals to improve transportation by trucks; and will generally comment on traffic conditions found in our overcrowded city streets.

As President of the Standard Freight Lines, Mr. Chaddick has been engaged in the trucking business for many years. Recognizing the need for improvement facilities and innovations in the trucking terminal situation, he has succeeded in initiating the construction of a number of privately financed truck terminals.

His report on the possibilities and plans to improve Chicago truck terminals should be interesting and practical.

October 27, Excursion

The next WSE excursion will be to the West-Southwest Sewerage Treatment Works of the Sanitary District of Chicago. It will take place on Saturday morning, October 27.

This is one of the largest and most modern sewerage treatment works in the world. A tour through it will be of interest to many branches of the engineering profession. The tour will take approximately an hour and a half.

WSE members are asked to arrive at 9:30 A.M. or closely after. Go to the north entrance of the Works, which is on 39th Street, one block east of Austin. From there turn south, from 39th to the gates. There you will be directed to parking lots. Information as to the exact starting point of the tour will be given when you arrive at the grounds.

The Committee who made arrangements for the tour hope that there will be a large turn-out of WSE members and feel that the excursion will be well worth the time.

October 22, WSE Annual Fall Dinner

This is a date every WSE Member should hold open. The Fall Dinner is a stimulating, interesting occasion. An opportunity to meet old friends and contact new Members.

The subject to be discussed by our featured speaker, Major Lenox R. Lohr, should be worthwhile. It is entitled, "Centennial of Engineering".

Major Lohr will explain the philosophy behind the Centennial and the plans being made to carry out the philosophy.

Major Lohr is accustomed to making a success of the projects he undertakes. He was General Manager of the Century of Progress, Chicago's World Fair, President of the Chicago Railroad Fair, and has held numerous other civic and national posts with marked success.

The Annual Fall Dinner will take place in the Furniture Club of America, 667 N. McClurg Ct. From 5:30 to 7:00 there will be a period of fellowship. At 7:00 dinner will be served.

Please send in your reservations early. Tables will be assigned in the order in which checks are received. On page 6 of this issue you will find an application blank for a reservation to the Dinner. Why not fill it in today? Attach your check. Put it in the mail. We want to see you at the Annual Fall Dinner!

October 23, Young Engineers' Forum

The Second Young Engineers' Forum, sponsored by the Western Society of Engineers, will start on Tuesday, October 23, 1951 and will run for seven consecutive weeks, except for Thanksgiving Week. The Forum will consist of seven dinner meetings, to take place in the WSE Dining Room. Assembly will be at 5:30. This year the theme of the Forum will be, "Engineering in Chicago Industry".

Forum Co-Chairmen Egloff and Sedwick have secured the following speakers:

Oct. 23	Utilities R. D. Maxon, Vice Pres. Public Service Co. of Northern Illinois
Oct. 30	Oil Industry Dr. D. J. Bergman, Chief Engineer, Universal Oil Products
Nov. 6	Light Manufacturing Col. John Slezak, President Turner Brass Works
Nov. 13	Railroads J. P. Kiley, Pres. Chicago, Milwaukee, St. Paul and Pacific Railroad
Nov. 27	Steel A. J. Cochrane, Asst. Dist. Mgr., Acme Steel Company
Dec. 4	Packing Industry Edward Foss Wilson, Pres. Wilson & Co. Rear Admiral C. C. Anderson, Chief Executive Engineer, Wilson & Co.
Dec. 11	Heavy Manufacturing A. B. Dollens, Vice Pres. & Gen. Mgr., Electromotive Division, G.M.C.

Registration for the course is limited to 100.
The fee is $25.00 per person for the series.

October 29, Hard Chrome Plating Applications in the Field of Tools, Gages, Molding Equipment, etc.

SPONSORED BY THE CHEMICAL AND METALLURGICAL SECTION

Mr. Harvey Jacobson, Vice President and Plant Manager of the Nestor Johnson Mfg. Co. will be the speaker. His subject matter will cover practical specifications for plating such material and he will give examples of various processes necessary to obtain the best results. He will use slides to illustrate his talk.

Mr. Matthew Dassinger, a member of A.E.S. and Superintendent of Metal Finishing of the Nestor Johnson Mfg. Co. will assist Mr. Jacobson.

Following the talk there will be a question and answer period. WSE members are invited to attend any questions or problems they may have on the subject.

November 5, Communication Systems Designed for the Power Industry

SPONSORED BY THE ELECTRICAL ENGINEERING AND COMMUNICATIONS ENGINEERING SECTIONS

John A. Doremus, Chief Engineer of Carrier and Control Division, Motorola, will be the guest speaker at the joint meeting of the Electrical and Communications Sections.

The use of communication systems on power lines for various purposes is steadily increasing. Channels are required for various control functions, telemetering and protective relaying purposes, as well as for speech. Carrier current on power lines has been used for this purpose for a considerable period. Recently micro-wave equipment has been introduced.

Mr. J. A. Doremus has done extensive work in this field and is well equipped to discuss the systems and equipment used. He will present comparisons of carrier current and micro-wave equipments to indicate the logical field for application of each type of system. He will use slides to illustrate his talk.

This is an opportunity for WSE members to receive a graphic presentation of newest developments in the field.

November 12, Illinois Central's Cairo Bridge over the Ohio River at Cairo, Ill., Improved and Modernized

SPONSORED BY THE BRIDGE & STRUCTURAL ENGINEERING SECTION

At this meeting an opportunity will be given to WSE Members and friends to hear **C. H. Mottier,** Vice President and Chief Engineer of the project, explain how the problem of altering and supplementing the existing substructure, and placing the new superstructure under traffic, was accomplished.

Mr. Mottier will explain how new 518 ft. and 400 ft. truss spans were erected at one side of the existing structure; the old spans moved out on launching sleds for final launching into the river; and the new spans rolled into position with a minimum interruption to railroad traffic.

This is the first time that this unique procedure has been accomplished on a job of such magnitude. WSE members will be among the first to hear the details of improving and modernizing the Cairo Bridge over the Ohio River.

Mr. Mottier will show many on-the-job pictures.

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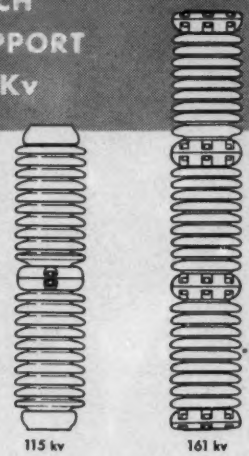

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OCTOBER 22

The Annual Fall Dinner

at the

Furniture Club of America

667 N. McClurg Ct.

Featuring

MAJ. LENOX R. LOHR

on the "*CENTENNIAL OF ENGINEERING*"

What is the philosophy underlying the Centennial of Engineering? What plans are being developed for the Centennial? These questions will be answered by Maj. Lenox R. Lohr at the Annual Fall Dinner. Major Lohr is Director of the Centennial of Engineering throughout the nation.

It is inspiring to know that he heads the Centennial. He is a member of the ASCE, the SAME, and other organizations. His brilliant work as General Manager of A Century of Progress, Chicago's World Fair of 1933 and 1934 is an example of what he can do—on a smaller scale—for the Centennial of Engineering.

At present Maj. Lohr is President of the Museum of Science and Industry in Chicago. He has held that post since 1940. Also he has been Director of Civil Defense for the State of Illinois, in 1950; from 1935-40 was President of the National Broadcasting Company; was President of the Chicago Railroad Fair in 1948-49; and he has held other honorary posts with distinction.

He is a graduate of Cornell; served thirteen years in the Army Corps of Engineers; has received honorary degrees from The Illinois Institute of Technology and from Knox College. He was awarded the Silver Star Medal for gallantry in action in World War I. He has written two books, Magazine Publishing, and Television Broadcasting.

Since Major Lohr has had such an outstanding career, WSE Members can look forward to an informative, colorful talk from him concerning plans for the Centennial of Engineering.

FELLOWSHIP AT 5:00

DINNER AT 7:30

Send in your Reservations Today

Tables assigned upon receipt of your reservation and check.

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WATER WORKING FOR MAN

By RICHARD D. HARZA
Junior Division WSE
Harza Engineering Company

Estimates tell us that the potential water power of the whole world is 672 million horsepower. I'll try to give these astronomical power figures some proportion a little later. Now, the distribution of this 672 million potential horsepower is quite interesting. About one-half of the total is on the continent of Africa, and more than one-fourth of the world today is in the Belgian Congo! Needless to say, practically none of this is developed. The three continents, North America, South America, and Europe, each have about one-eighth of the world's reserve, while Asia has twice that. Russia, though, has but a small portion of Asia's potential. North America and Europe lead the other continents in developed water power, each having realized about 44% of the potential. For its share of the actually developed water power of North America, the United States now has 21 million horsepower. But it is important to notice that seven and one-half million installed horsepower, more than one-third of the nation's total developed water power, is owned by the Federal Government, and the Federal Government is now planning to almost triple its water power capacity with extensions and new projects. I repeat: The Federal Government now owns one-third of all installed water power in the United States.

Let's look for a moment at what water power means to you personally. By taking the total of consumers electricity generated (one-third by hydro-electric, two-thirds by steam, and a bit by internal combustion) last year, one will find each American's share of this energy is equal to having six powerful slaves running on a treadmill for him non-stop for ten hours a day, 365 days a year!

As your living standard is above average, then this number of "equivalent slaves" will increase, but always, one-third of them will represent what water power is doing for you.

In thinking of hydro power, we generally consider it the most efficient source of energy. Plant efficiencies of 85% and 90% are not unusual. These efficiencies are based on the height of fall of the water at the sites. Actually, though, the most we are able to reclaim is about 0.03% of the energy of the water cycle. The largest part of the energy is lost in creating winds when the water condenses out of the clouds.

Any discussion of the general power picture today would not be complete without mentioning atomic energy. From the standpoint of power, atomic energy should be considered as an alternate fuel for conventional steam generating stations, and since fuel costs are only a small part of the present costs of producing and delivering electrical energy, it can be seen that even when atomic energy becomes cheaper, it will not create a revolution in the power field.

If, however, a means of producing electrical energy without generators is perfected, then there will be radical changes in the production of power. Such a method of electric energy production would by-pass the turbines and generators and control equipment which now are major expense items in electricity production, and cause electrons to flow in the power line directly from the atomic source. This would cause a great change in the present power production picture.

When one considers the history of water power, he can see two changes which greatly accelerated its development. The first of these was the production of metal in sufficient quantities to make pressure vessels. As example, remember that where the Romans built magnificent masonry aqueduct structures to convey open flowing water, we would accomplish the same end by the simple expedient of a pipe on the ground. But even after metals became available, another limitation on the production of power controlled the size of power installations. This limit was a lack of transmission facilities. When the transmission of power by electricity became practical, about 1890, then water power started a rapid development which has not slackened since.

(*Continued on Page* 8)

(*Continued from Page 7*)

But let us get a little background in our history of water power. In 1750, in the western part of Scotland, James Finlay formed a tea importing company. His company undertook various power developments on the River Ayr. In 1825, James Finlay and Company joined with a local cotton milling concern to develop a fall of forty-eight feet on the Ayr. The resulting power plant had four "overshot" water wheels of fifty-one foot diameter turning at three revolutions per minute. Power produced was 500 horsepower, and it was delivered directly by shaft to the mill and the tea plant. An interesting feature of the plant was the cast iron gears fifty feet in diameter attached to the waterwheels. Another point of interest is that these wheels were only replaced in 1949, after 125 years of interrupted service!

Today, we have adequate methods of handling water under pressure. We have economical facilities for transporting power for hundreds of miles. And we have a constantly growing demand for power. The result can be seen on the Columbia River at Grand Coulee. Here, there are two and a half million horsepower developed on a single site. In little more than a century, an increase in power at a single site of 5,000 times! The average American can think of his two "equivalent slaves" and remember that they are water power.

The most efficient hydraulic prime mover available to man until the late 19th century was the mill wheel built about 1860.

Then the availability of pressure resisting water conductors and electrical distribution systems made larger hydro plants practical, such as the steel penstocks for the Pont de la Reine plant in France.

Simply stated, water under great pressure squirts out a nozzle, and strikes on the buckets (blades) of the large wheel. This, of course, causes the wheel to turn, and the generator on the other end of the shaft produces electrical energy.

Impulse Type Wheel

The Dixence plant in Switzerland employs the "impulse type" wheel. This plant has the world's record for height of developed head, 5750 feet! This head gives a water pressure of 2500 psi. Penstocks (pressure pipes) carry this formidable force. Bands of high strength steel reinforce the penstock. This arrangement was necessary because it was impossible to fabricate pipe plates of sufficient thickness to withstand the pressure.

The "impulse type" wheel just discussed is one of the several types of water wheels now used; it is used for high head developments. These wheels are made for heads of 800′ to 6,000′, and the largest installation of an impulse wheel is the 70,000 HP unit near Sao Paulo, Brazil.

For developments of lower heads, different types of water wheels are used. The most important types of these are the "Francis" wheel (an American development) for medium heads of 100 feet to 1,000 feet; and "Kaplan" wheel for low heads of 10 feet to 100 feet. These wheels are usually on the bottom end of a vertical shaft. The water is conducted to the wheel by a "spiral case".

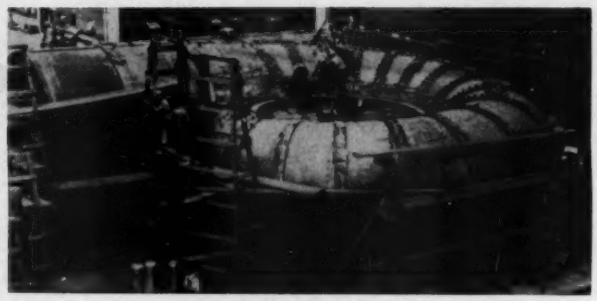

Figure 1

Figure 1 shows the outside view of a spiral case of the "Francis" wheel. This shape of water passage forces the water to flow towards the center and then down around the blades of the turbine (water wheel).

The Kaplan Turbine

The Kaplan turbine is actually a large adjustable blade propellor, and if one visualizes water flowing to the center of the picture and then down, one can understand how this swirling water will cause the turbine to turn. The swirling effect is given to the water partly from the shape of the spiral case, and partly from the vertical "guide vanes". These guide vanes look something like a ring of vertical shutters around the turbine, and their setting controls the amount of water flowing into the turbine. This regulates the power output of the machine.

The Francis Wheel

The Francis is a cross between the Kaplan and impulse wheels though it does not have adjustable blades. The most powerful of all hydraulic turbines are the Francis type wheels at Grand Coulee, 165,000 HP each being the rating.

Dams

The Hoover Dam, with a height of 726 feet, is the world's highest. It is an arch dam. In this type of dam, the force of the water acts to wedge the dam into the sides of the canyon, and this effect results in a smaller required weight of concrete for arch type dams than for other types.

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(*Continued from Page* 8)

WATER WORKING FOR MAN

Figure 2

Figure 2 shows the highway across the top of Hoover Dam joining Arizona and Nevada. Notice the horizontal structure on the distant bank. This is the spillway (essentially a water passage to allow floods to pass the dam without harming it).

Hoover power plant yields 1,800,000 HP and is one of the largest power plant structures in the world. The volume of Hoover Dam is 3,250,000 cubic yards. It is of interest to note that the Pyramid of Giza, built about 4,000 years ago, had a masonry volume of 3,100,000 cubic yards, and thus was but 2% smaller in volume than Hoover Dam!

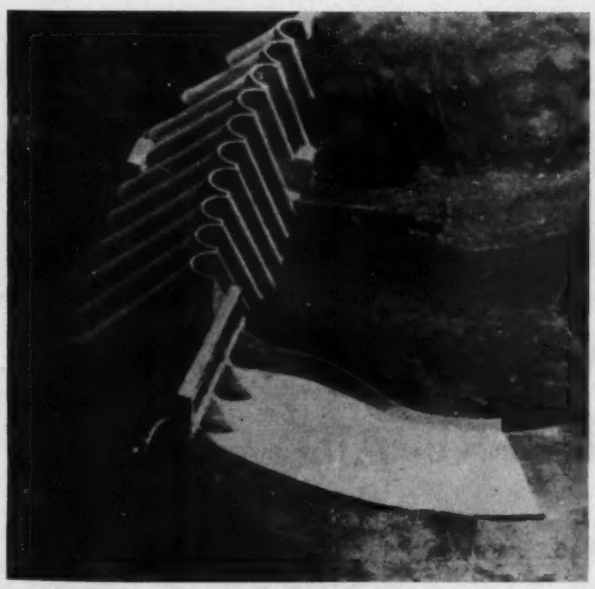

Figure 3

Figure 4

Figures 3 and 4 show a scale model of Bartlett Dam on the Verde River in Arizona. It is 273 feet high, and is the highest multiple arch dam in the world. This type of dam is especially adaptable to situations involving bad rock foundations, cheap labor, and expensive concrete materials. Note the large spillway structure at the side of the dam.

(*Continued on Page* 18)

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ENGINEERING MANPOWER

Addressing the Engineering Manpower Convocation in Pittsburgh, Pennsylvania Mr. Trytten Explains the Government's Policies

by M. H. TRYTTEN
National Research Council
Washington, D. C.

It should be clear from what has already been said today that the major problems confronting the nation are in the field of manpower or are closely related to manpower.

It is also true that in the manpower field the problem is most acute and has its greatest impact for the age groups coinciding with the age of college attendance. This makes the present manpower crisis extraordinarily important for the future because the actions which are taken to solve these problems will have their major effects not so much now as in the future—five and ten and twenty or more years from now. It is not too much to state that an unwise resolution of these problems could fundamentally alter the nature of our civilization and dissipate its essential strength to the point where it will be extremely vulnerable in any future conflict.

The most important characteristic of the present situation is that there are no precedents for most of its features. 1951 is so different from any other year of decision that little help can be found by scrutinizing the past. We have had experience with the problems of both peace and war. But this is neither war nor peace but an uneasy and fluctuating admixture of both. The tempo of the present crisis can not even be measured because the initiative has not been with us. We are like a football team which must get ready for a game but has no schedule. In the meantime, we have determined both to maintain and preserve our civilization and to assume a posture of defense. We shall have both guns and butter. We shall do all of this with any sort of controls on our manpower confined to a very small proportion of our youth, the males of little more than a half dozen years apart in age at the maximum. And withal the motivation of national crisis is largely lacking. This small group of young men must furnish the armed force manpower supply and must furnish the hope of maintaining our supply of trained personnel in all categories, for the present and the future. This is much more of an era of training and preparation for conflict than a period of warfare. Therefore, for the present the mobilization of both manpower and production should be considered primarily a preparatory and training effort. The fact that some portion of those in Service must see actual combat as severe as in any previous war, complicates both planning for training and combat.

The situation is, therefore, so unprecedented and so different in its implications that the past has little to offer in the way of guidance. That which it appears to have needs to be looked at with considerable skepticism. Seldom has it been so necessary to discount the applicability of the methods of the past and to base design on the most cold-blooded analysis of the trends and events of the present. And yet to most of us the common approach to the problems of the present is to adopt the methods of the past. Seldom has this been so dangerous as now.

Complicating this whole situation is the fact that few appreciate the fundamental role of the United States in the previous two wars. There need never be any depreciation of the heroic quality of American military personnel, nor of its leadership. Nevertheless, the real secret of American success in the last two wars did not lie in any surprising superiority either of its military personnel or their leadership regardless of how good that may have been. The superiority of American arms was primarily due to the productive capacity of the nation where that phrase includes the full technological gamut of operations beginning with the creative and inventive efforts of American scientists and inventors at work, the development phase where American industry prepares for a powerful and speedy job of reducing the technological concept to the finished design suitable for rapid and accurate reproduction on a mass basis, and finally the production phase in which the enormous production facilities of the country pour out in suffi-

(*Continued on Page* 12)

(*Continued from Page* 11)

cient quantities military equipment to overwhelm the opposition. This is the real significant strength which has been the American secret weapon. Any military planning for the present crisis or for future developments which do not consider this as perhaps the most important element in planning must therefore necessarily be seriously faulty.

It should not be necessary to document this statement since the history of World War II should be sufficiently fresh in our minds as to make that recapitulation unnecessary. However, it is very easy to forget or to misunderstand, or to fail to realize the true significance of events. Perhaps many have already forgotten the darkening days of 1940 and 1941 when American manpower was being mobilized for Service. At that time, there was not even in existence the simple military tools with which they could drill and be trained, not to speak of the equipment for actual combat of those who had already been trained. Field maneuvers were carried out with wooden sticks for guns, and wooden mock-ups for tanks. Yet within less than a half dozen years, the American Nation had become the strongest nation militarily in the world; had met and conquered two great military opponents with extraordinarily good equipment and great numbers of seasoned personnel, and had created in the process and during the conflict a whole host and variety of military devices so extraordinary that they have forever changed the nature of military conflict itself. I refer in this last to the atomic bomb, the proximity fuse, the microwave searching, ranging and gun laying equipment, and a number of other devices of great power. Also during this period there was created a practical, effective, and extraordinarily highly successful control of the environment in which combat occurred, and their diseases, pests, and destructive elements affecting both man and equipment so that the loss of manpower, due to noncombat causes, was reduced to an all time minimum by a substantial factor.

It is probably too much to state that these facts have been ignored up to the present time because this is not true. But there is clearly far from adequate understanding of the fact that these phenomena which so spectacularly characterized World War II, were due primarily to the fact that this nation fortunately possessed an extraordinary number of highly trained people in the various sciences and engineering. This phenomenon was not due to any extraordinary superiority we may have possessed in raw materials or other physical possessions. It was due to our fortunate possession of trained minds. It was due to our thousands of engineers graduating annually from American colleges moving immediately into the practice of their profession in highly organized and highly integrated staffs in the production establishments of the nation. It was due to the many young men rigorously trained in the sciences possessing the most advanced scientific training of all time and ready to apply their talents in a far flung system of laboratories throughout the nation. It was due to the training of other thousands of people in other advanced categories such as those in the science and business organization, the science of human relations, and in the fields of linguistics and other areas which became so important in dealing with the problems of a war, global in character and impinging on practically every type of humanity and social and political structure in the world.

It is worth commenting here that had we not enjoyed a period of twenty years between World War I and World War II in which the training of American youth could go on without interruption and with ever-increasing social support these things would not have happened. Any interference whatever with the full flow of American youth during that period and their training would necessarily have reduced the total available supply in 1941, a supply which was in no sense surplus at any moment for the accomplishments which were necessary for victory. Had the supply of engineers and scientists on our side been less, most surely the speed and effectiveness of our technology must have been less. The result would have been less powerful equipment and at a later date, to be paid for by much greater casualties, loss of strategic objectives, greater costs in men, time and equipment, and eventually greater losses to the world in disintegration, destruction and disorder.

Let us take one specific example alone. The average age of electronic scientists in World War II, who were registered with the national roster, was 26 years. At the mid-point of that conflict had their training been interrupted for a year or two, it is mathematically certain that the electronic accomplishments of World War II would have been less, the promptness of development of most of the equipment would have been less and consequently the availability of that equipment for its extraordinary important strategic role would have been less and later.

These facts have not been adequately considered in the manpower planning which has taken place up to the present time. That this is true can be seen from an analysis of the present situation with regard to the maintenance of the armed establishment at its target level of three million, five hundred thousand.

The summer of 1951 has seen an apparent lull in the manpower demands of the Services. This is due, however, to the extraordinary rapidity with which

(*Continued on Page* 14)

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WSE Personals

Edwin C. Knuth, of E. C. Knuth & Co., Milwaukee, an enthusiastic WSE member, is at present confined to his home, 8204 Brookside Place, Wauwatosa 13, Wisc., due to a condition in his right arm. He would like his friends to know that he is trying to catch up on his personal correspondence as quickly as possible.

Paul Rogers, WSE Member with Sargent & Lundy, has recently written a paper, "Design of Large Coal Bunkers" which has been published as a Proceeding Separate of the American Society of Civil Engineers. Those interested may receive copies by writing to the Society's Headquarters, 33 W. 39th St., New York 18.

Dr. Gustav Egloff continues on the go. His busy fall schedule includes the following commitments: On September 28 he will address the Younger Men's Group of the Union League Club. He will speak on "Living on Petroleum." (Recently he showed the nation how to "Dress with Petroleum.")

Dr. Egloff will go to St. Louis for an October 1st address to the St. Louis Section of the American Chemical Society. There he will speak on "Modern Processes in the Oil Industry."

He will be one of the featured speakers during Oil Progress Week, sponsored by the Oil Industry Information Committee, speaking on "The Modern Oil Industry" before a large Saginaw Valley Oil Progress meeting at Frankenmuth, Michigan.

Also in connection with Oil Progress Week, on October 18 he will address about 400 men and their guests at Indianapolis, Indiana. Here, also, he will speak on "The Modern Oil Industry."

W. R. Jefferies, a Life Member, is now located at 2809 Patterson Ave., Winston-Salem, N. C., superintending the erection of a Research Laboratory for Schmidt, Garden & Erikson, Architects of Chicago.

John A. Granath is a radio-radar technician, in the U. S. Marine Corps Reserve, having been called right after graduating from the Illinois Institute of Technology.

An increasing number of WSE members are being called into the Armed Services. Recently the following members have left civilian life:

J. Wesley Ooms, graduate of the Illinois Institute of Technology, and formerly with the Fire Underwriters' Inspection Bureau of Indianapolis;

Edwin W. Storer, also a graduate of Illinois Tech., who was an Inspector for the Indiana Rating Bureau at Indianapolis;

George R. Hall, a graduate of Marquette University and formerly with the Illinois Bell Telephone Co. Pvt. Hall's address is now: Camp Breckenridge, Ky., 101st Abn. Division;

Lawrence J. Sundlie, who has been recalled to the U. S. Air Force. He was with the Inland Steel Company at East Chicago, Indiana;

Sidney E. Bates, Jr., now a Lieutenant with the U. S. Navy in Korea. He was employed as a Mechanical Engineer with Bates Engineering Works;

Rolf H. Jensen, now in the Army, and formerly of Cook County Inspection Bureau;

A graduate of Illinois Institute of Technology, Class of 1937, and a WSE Member since 1936, **Herman M. Ross** has been appointed Chicago District Manager of Graver Water Conditioning Co., manufacturers of water treatment equipment. Mr. Ross is being transferred to Chicago from Cleveland, to replace Harold R. Fosnot, who, in turn, is being transferred to the home office in New York.

Mr. Ross has been with Graver since 1946, in the water treatment section. During World War II he was Chief Sanitary Engineer for the U. S. Army's 7th Service Command Sanitary Corps.

The WSE is delighted that Ross, who steadily retained his membership while in Cleveland, is back in Chicago and can personally identify himself with WSE activities.

Paul Stiefel has just informed us that he is Junior Engineer with Glenn L. Martin Company, Baltimore, Md., having accepted this position after receiving his degree from Illinois Institute of Technology.

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the Services were augmented from a manpower total from less than a million and a half men at the outbreak of the Korean incident, and the present total of somewhere in the neighborhood of three and one half million. This rapid build up, however, was due to certain extraordinary methods and operations. These included:

1. The extension of enlistment contracts which occurred immediately after June of 1950, so that those already in the Services were arbitrarily given one year of added service.
2. The involuntary recall of reservists and organized reserve units.
3. The wave of voluntary enlistments in large measure precipitated by popular reaction to the draft situation during the winter.
4. The induction of about 6,000 through Selective Service.

These extraordinary methods will not be available indefinitely. Reservists are now by law eligible to apply for discharge after 17 months' service. Organized units can be retained for more than 24 months. The present appropriation bill for the Armed Service contains a further limitation for certain types of reserve personnel for only 12 months of service. The effect of all of these facts is that the reserve strength available at this time will rapidly be used up or become unavailable. Similarly, the extension of enlistment contracts can occur only once under the present law. Also the pool of persons available for military service who have not previously seen service and who are between the ages of 18½ and 26 is very rapidly becoming depleted. It is estimated now that less than a million men over the age of 18½ years are available for induction or enlistment.

With a rapid turnover which seems certain for the Armed Service for the next 21 months because of these facts mentioned, it seems possible to predict at this time that in something considerably less than two years the manpower available for military induction above the age of 18½ will disappear. From then on the strength of the Armed Services will need to be maintained through the influx solely of the supply of manpower coming of military age, that is, at that time young men passing the age limit of 18½ years will be the sole supply of manpower from which to maintain the Services at the level of 3½ million.

In view of this fact, it is worth examining how adequate this supply can be and I invite your attention to Tables I and II. Table I is a simple calculation of the number of persons necessary on a rotational basis and needed annually if the Services are to be maintained at the best target level, and under the assumption of a given length of service which is indicated in the Table. It is here assumed that the length of service is the same for all. It will be noted that the import of this table is that to maintain from this supply of oncoming youth a military establishment of 3½ million men will require over four years of service for each if no exemptions are promised for anyone.

Table I

Annual increment needed to maintain the strength of the active Armed forces at 3,500,000 men:

(a) Average period of service	(b) Annual Requirement	(c) % of whole age group reaching maturity	(d) % of avail. fit expectancy from each age group
2 years	1,750,000	145.8	202
3 "	1,166,000	97.1	135
4 "	875,000	73.0	101
5 "	700,000	58.3	81
6 "	583,000	48.6	67

This table is based on 1,200,000 males coming of military age annually. In actuality the number for the current year is less than that by one-eighth, (150,000). But the number is used as a reasonable expected average for the present decade. 72% may be expected to be acceptable for training (864,000) and this number yields the percentages in column (d).

Table II is more realistic, and more representative of the probable situation. It is based on the fact that the length of service is not the same for all members of the group. Some persons are "careerists" remaining in the establishment for the better part of their active careers, others stay in military service while not for a whole career, yet for periods of several years and above a single enlistment. Defining as "careerists" all persons who remain in military service more than one enlistment period, it can be estimated that the number of such persons in military service at the present time is probably about 750,000. It is also estimated that their average length of service is approximately 10 years. With these estimations, one may then reduce the number of persons to be provided by inductions through Selective Service, or one term enlistments reduce to two million, seven hundred and fifty thousand. However, it is to be noted that to maintain 750,000 "careerists" in the Service for an average length of 10 years will require a minimum of 75,000 per year and possibly a somewhat greater number in view of the affects of attrition. The number of persons coming of military age is for the present approximately 1,050,000. Of these not over 72% can qualify

(*Continued on Page* 26)

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THE ENGINEERING MIND IN BUSINESS

Address at WSE Sponsored Luncheon of the 1951 Midwest Power Conference

By Colonel John Slezak, W.S.E.
President Turner Brass Company

Gentlemen:

I feel very inadequate to talk to this selected and distinguished audience about anything, and much less about this intriguing subject. What I have to say about it is elementary, simple, and, by and large, self-evident.

Several days ago I had the privilege to discuss this meeting with your chairman, Mr. Sedwick. His wholesome and sincere interest in the welfare of the younger engineer simply took my breath away. As a matter of fact, this subject is entirely his idea, and I am sure that he could handle it more effectively than I can. At this meeting he was graciously helping me to crystallize my own thinking about it, and I do hope that the results will come up to his expectations.

During the past fifty years we have gone a long way in developing ways and means toward more effective utilization of our material resources. Our standard of living is admired and envied by the rest of the world. As a matter of fact, even those who hate us and our way of life are greedy for the results that our way of life has produced. However, in spite of the tremendous technological progress that has been made, we have almost ignored what, to me, is our greatest national resource—that capacity of our people to create and to produce. Yes, we have left the utilization of this tremendous potential almost entirely to chance or, at best, we have hardly scratched the surface.

How many of us can say that we are utilizing the people associated with us fully and effectively up to their capacity? None of us I am sure. Then how many of us are conscientiously working on this problem according to a predetermined plan and schedule? Very few indeed. But what is worse, in most cases we do not even seem to recognize that there is a problem. Let me give you some examples.

In the operation of our manufacturing establishment, the function of purchasing raw materials, supplies, and, in other words, tangible things, has always and is now receiving very prominent attention. The job is generally handled by a top flight man, invariably an officer of the company. However, the same does not apply to the purchasing of labor. This job, in spite of its importance and its tremendous potential in making the company's profits possible, is too often delegated way down on the organization charts to a man buried in details, routine, and red tape.

Now let us briefly compare these two jobs. Relatively speaking, the job of purchasing material things is simple, definite, and specific. There are well established and recognized standards of performance both as to quality and price. The engineering specifications take care of what you get, and competition, under normal conditions, takes care of the price. Therefore, barring fraud, you cannot get hurt very much or for very long no matter who does the job. On the other hand, the purchasing of labor productivity is intricate and indefinite, with very few, if any, purchasing standards and specifications to guide you. Because of the accepted sloppy habits in the industry you are buying the time the worker spends on your premises, not his productivity. What you pay—in other words, the price—is specific and definite, but what is delivered to you depends upon the Grace of God and your own ingenuity. But let me carry this a bit farther. In many, if not in most cases, labor is the largest single item of cost, and in the total cost of national goods and services the cost of labor is approximately 80% to 85%. My friends, we could apply more engineering horse sense in our approach to this problem. However, this type of thinking is not confined to the industry alone—not by a long shot. Let me give you some examples from the experiences of our government.

The Federal Government spent $1,300,000 on the Bixby Dam, South Dakota, irrigation project and then discovered that the water they were damming up would mean ruin for the farmland on which it was to be used. It seems that the water contained a destructive chemical. Now using a little engineering horse sense, a simple chemical analysis in advance would have saved the cost of acquiring the dam-site, constructing new houses for laborers, etc., etc.

The big Thompson water project in Colorado was authorized to cost $44,000,000. It ended up costing $131,000,000. The Hungry Horse Project in Montana was estimated to cost $6,000,000—it ended costing $93,000,000. The Works Project in the Central Valley of California was to cost $170,000,000; it ended by costing over a billion dollars.

Our Government built a dam on the Snake River in Wyoming. This project was to irrigate approximately 100,000 acres of land. When the job was done they found that they had water enough to irrigate only approximately 15,000 acres. Yes, a bit more of the engineering mind could be applied to the work that our Government is doing.

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Several weeks ago I was called on a case in which a medium sized corporation moved its operations from a midwest city to another community. When I asked them why they moved I got loads of conversation but no supporting facts. A quick analysis disclosed that it will cost them approximately $100,000 per year more to operate from the new location. Certainly they should change the pattern of their thinking habits. By the way, this particular organization has an unusual amount of engineering talent in its employ, but, my friends, the payoff is not on what you have but on what you use and deliver.

K. T. Keller, Chairman of the Board of Directors, Chrysler Corporation, once told me that the hardest part of his job was when called upon to make decisions without adequate supporting facts. And yet, we both in the business world and in the engineering world are making daily decisions without adequate supporting facts—and I am not even mentioning the political world. Worst of all, because of sloppy habits, we do this even when the needed facts can be had with but little effort. You and I know that our files and libraries are bulging with facts and information that are seldom if ever used. As a matter of fact, again and again we are rediscovering known and recorded facts at a tremendous expense of time and money. It seems to me that, as Tennyson so aptly put it, "Knowledge comes but wisdom lingers."

I could go on and on and give you illustration after illustration, but I am sure that you could give me even more of them from your own experiences. However, it all adds up to this—ineffective utilization if not downright waste of human resources, or, in other words, sloppy, undisciplined thinking in action—faulty habits in the approach to the solution of everyday problems.

By now I am sure that you all realize what I mean by applying the engineering mind in business. But carrying it a bit farther, and at the risk of over-simplification, I would say that the engineering mind in business means application of the same orderly procedures, the same honesty of purpose, the same respect for truth and facts that are the very foundation of the scientific and the engineering world. Or, as the Good Book puts it, "Ye shall know the truth and the truth will make you free."

Then what is the answer? It seems to me that more effective utilization of our human resources deserves at least as much attention as the utilization of our material resources has been receiving during the past fifty years.

We spend time and money in our colleges training our youngsters in various professions, but we do little or nothing in preparing them to use this newly acquired knowledge effectively to their own and to society's best interest. We leave this almost entirely to chance. Would it not be wonderful if, for instance, every young engineer graduating from a school were trained not only to evaluate the assets he has acquired there in terms of their application to his potential jobs, but also in terms of their use in his being a more effective member of society and a better citizen of his country!

It seems to me that much too often we are wastefully ineffective because we ignore the simple and the obvious. For instance, we certainly should apply at least the following fundamentals in the approach to our everyday problems:

1. Know what you are trying to accomplish; know what your mission is; know it clearly and definitely. In other words, be very specific in the statement of your problem. Most of our sloppy thinking starts at this point.
2. Know how you are going to attain the desired results; be definite; be specific.
   In other words, know not only where you are going but also have a clearly charted map showing how you are going to get there.
3. Have a schedule. In other words, know definitely and specifically when each element of and the entire project will be completed. That gives you the only reliable basis for control.
4. And perhaps the most important—Be honest with yourself. Keep a keen sense of intellectual integrity. In other words, if subsequently developed facts indicate that your course should be changed or the project abandoned, follow the facts, do not alibi.

I know, my friends, that to you engineers this is very elementary, kindergarten stuff, but I sincerely believe that if our youngsters were drilled and disciplined to do at least this minimum amount of orderly thinking in the approach to their everyday life problems, we would be making great strides toward a more effective utilization of this greatest of all underdeveloped resources—the human capacity to create and to produce.

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Tool Engineers Conference at U of I October 27, 1951

On Saturday, October 27, there will be a conference for tool engineers on the University of Illinois Campus.

Registration and inspection of M.E. Laboratories will take place from 8:00 to 9:30 Saturday morning, followed by Technical Sessions, held concurrently. The sessions will be devoted to Recent Developments and Applications of Metal Cutting Research and Electronics Applied to Machine Tools.

Luncheon will take place at the Urbana-Lincoln Hotel. T. J. Donovan, Jr. will give a message from the A.S.T.E., and A. O. Schmidt will speak on the Machine Tool Show at Paris, France, and Tool Engineering in Europe.

The technical sessions will continue after lunch. A Round Table Discussion of Metal Cutting Problems will be discussed by Bernard Better, Harry W. Highriter, M. E. Merchant, W. H. Oldacre, and A. O. Schmidt. The second afternoon session will be on Considerations in the Depreciation and Replacement of Machine Tools and Equipment.

The conference dinner will take place at 5:45, in the Urbana-Lincoln Hotel.

There will be a special program for ladies.

The registration fee for the conference is $5.00 per person. No registration fee is charged ladies who attend.

Registrations will be accepted in advance, payable to R. K. Newton, Supervisor of Engineering Extension, 713½ South Wright Street, Champaign, Ill. Otherwise you may register in the lobby on the first floor of the New Mechanical Engineering Building, from 9:00 to 9:30 Saturday morning, October 27.

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(*Continued from Page 9*)

Figure 5

Figure 5 is Stony Gorge Dam near Yakima, Washington. This is a "slab and buttress" type of dam, sometimes called Ambursen Type. Structurally, it is similar to the multiple arch, except that it has straight slabs in the face rather than concrete arches. Another type of spillway (i.e., over the center of the dam) is shown here.

The "massive buttress" type dam is currently a popular type in Europe.

Figure 6

Tongland Dam and head panel are shown in Figure 6. Here is an arch dam in the background and a spillway in the foreground. Between the two is a fish ladder. It looks something like a flat staircase, and permits the fish to pass the dam.

Tieton Dam, near Yakima, Washington, is a good illustration of the earth and rock fill type of structure used extensively in the U.S. This dam, completed in 1925, has a slender concrete wall for water-tightness (maximum height of 321 feet) at its center. On each side of this is compacted earth for stability, and on top of the earth is gravel and rock for stability and erosion resistance.

HYDROELECTRIC DEVELOPMENT SCHEMES

Now that the principal types of water wheels and the important types of dams have been illustrated, it remains to indicate how these elements are combined to create power.

A cutaway of Hoover Dam and power plant readily shows how the tunnels through solid rock provide water passages for power and passing floods.

The power houses of Hoover Dam are reinforced concrete structures which have been given severely functional architectural treatment.

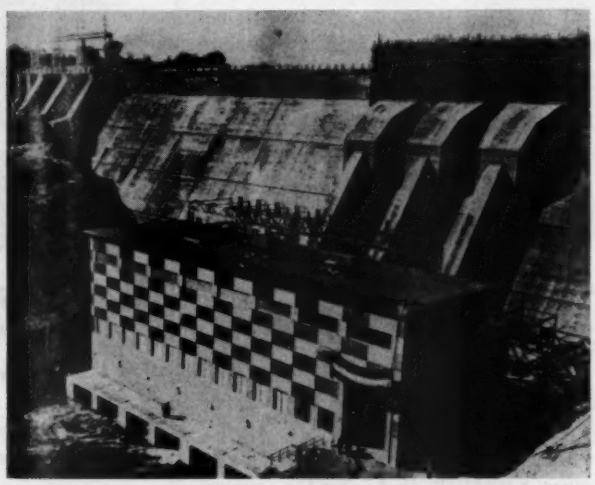

Figure 7

Figure 7 is a view of the Stewartsville Hydroelectric Development completed in 1949 in Ontario. This is a conventional development with a concrete gravity type dam. Of special interest is the architectural effect gained on the powerhouse by alternating the direction of the slats in the concrete forms. Simple, but effective.

(*Continued on Page 24*)

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Natl. Conference Industrial Hydraulics Nov. 7 and 8th

A number of WSE Members will play a prominent part in the National Conference on Industrial Hydraulics during its seventh annual meeting November 7 and 8 at the Sherman Hotel. The Conference is sponsored jointly by the Graduate School of Illinois Institute of Technology and the Armour Research Foundation of Illinois Institute of Technology. WSE is one of the cooperating agencies.

The Chairman of the General Session, which will formally open the Conference, is W. A. Lewis, well known to WSE, and Dean, Graduate School, Illinois Institute of Technology. O. W. Eshbach, Dean, Northwestern Technological Institute, will be the featured speaker at the Luncheon Session that same day, discussing, "Science and Engineering."

Harry Adams, of Hannifin Corp. will be chairman of the November 8 morning technical session on Material Handling. F. W. Edwards, General Manager, Centennial of Engineering, will be Chairman of the Luncheon Session on November 8.

J. T. Rettaliata, Vice President, Illinois Institute of Technology, is on the Board of Governors, Otto J. Maha, Vice President, Hannifin Corp. is on the Conference Committee. All are WSE Members.

The Technical Sessions of the Conference will cover the following subjects: Instrumentation, Automotive, Civil Engineering, Pumps, Material Handling, Packings and Filters, Viscosity Measurement and Hoses, Accumulators and Presses, Oil Wells and Fluid Transportation.

All registrants will automatically receive Volume V, Proceedings of the Conference, as soon as it becomes available. Proceedings will contain the complete list of all technical papers presented.

The Secretary of the Conference is J. G. Duba of the Department of Civil Engineering, Illinois Institute of Technology, and another WSE Member.

Electronics Conference at Chicago Oct. 22-24

The Seventh Annual National Electronics Conference and Exhibition is scheduled for October 22, 23, and 24 at the Edgewater Beach Hotel. This national forum on Electronic Research, Development and Application will center about the theme, "Electronics for Defense." It is sponsored by the American Institute of Technology, Institute of Radio Engineers, Northwestern University, and the University of Illinois.

A $3.00 registration fee covers all the technical sessions of the Conference. Attendance at the luncheons and the purchase of Proceedings are optional. There is a special advance registration price of $21.95 to cover all Conference activities. It is hoped that registrations will be made early, by mail, to facilitate handling.

A detailed, advance program of the sessions can be secured from Karl Kramer, Executive Secretary, National Electronics Conference, Inc., 852 East 83rd Street. All checks and correspondence on registration and general activities of the Conference likewise should be addressed to Mr. Kramer.

Field Welding of Aluminum Tanks

Reprints are available of "Field Welding of Aluminum Tanks," an article describing the erection procedure for a 200,000 gallon and six 30,000 gallon aluminum tanks.

The welding sequence used to prevent distortion or warping of the plates is discussed and photographs show each step during the erection of the tanks.

Reprints of the article may be secured from the Chicago Bridge & Iron Company, 332 South Michigan, Chicago 4.

Swiss Engineering Industry Strike Free Since 1937

The mechanical engineering industry in Switzerland has operated free from strikes of all kinds since 1937, Dr. F. Oederlin, managing director in charge of engineering, Sulzer Brothers, Ltd., Winterthur, Switzerland, told The American Society of Mechanical Engineers at the Society's fall meeting recently held in Minneapolis.

This has been accomplished under an anti-strike agreement between the Swiss mechanical engineering and metal industries and the corresponding trade union, which was signed 14 years ago. Dr. Oederlin said the agreement applies irrespective of the membership of a trade union. In the large mechanical engineering plants, he pointed out, such membership does not exceed about 30 per cent of the total number of workers.

"Caution Money"

"Each party to the agreement must deposit caution money, and in case of infringement of the terms of the agreement heavy fines may be imposed," the Swiss engineer said. "It is laid down in an accompanying memorandum that the parties to the agreement will seek to foster the good relations prevailing between employers and employees and will not allow them to be hampered by the pursuance of aims dictated by trade union policy. The agreement is expressly based on mutual trust and its stipulations must not be exploited for political or propagandistic purposes."

Dislike Cooperative Research

Dr. Oederlin, who reviewed his country's engineering achievements, said, "Switzerland demonstrates the fact that mammoth corporations are not essential to great technical accomplishments. The fiercely independent national character made for a dislike of cooperative research and developments within industry or under government sponsorship." This and an uncompromising national policy for patent licensing whereby patents are made the exclusive property of the licensor if at all possible, have made Switzerland's engineering achievements possible, in Dr. Oederlin's opinion.

"It is the belief of the leading Swiss industrialists," he said, "that the costs of research and development should be borne as far as possible by industry itself and a firm's expenditure for this purpose must therefore be commensurate with its own financial resources. Even so, the sums thus spent are often considerable in relation to turnover," he said.

"Research activity is as a rule limited to practical ends; the fundamental scientific research is, generally, left to the Swiss Federal Institute of Technology or other similar institutions, with which the firm maintains regular contact and in some cases undertakes active collaboration," said Dr. Oederlin. "Fundamental research is only carried out inside the firm in exceptional cases, where problems are encountered that are of great importance from a business standpoint for the technical development of certain essential products and processes."

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WSE Applications

In accordance with the By-laws of the Western Society of Engineers, the following names of applicants are being submitted to the Admissions committee for examination as to their qualifications for admission to membership into the Society in the various grades, i.e., Student, Associate, Member, Affiliate, etc. All applicants must meet the highest standards of character and professionalism in order to qualify for admissions, and each member of the Society should be alert to his responsibility to assist the Admissions committee in establishing that these standards are met. Any member of the Society, therefore, who has information relative to the qualifications or fitness of any of the applicants listed below, should inform the Secretary's office, 84 E. Randolph St., RAndolph 6—1736.

26-83 Zenas W. Bliss, Sales Engineer, General Electric Company, 840 N. Canal St.

27-83 John E. Birch, Owner, John E. Birch & Company, 3331 S. Oak Park Ave., Oak Park, Ill.

28-83 Ernest Ahlskog, Structural Engineer, Graham, Anderson, Probst & White, 80 E. Jackson Blvd.

29-83 Murt A. Shea, Telephone Engineer, U. S. Navy, District Public Works, Ntc. Bldg. 1A, Great Lakes, Ill.

30-83 Jack A. Mitchell, Draftsman, Lloyd-Thomas Company, 4411 N. Ravenswood Ave.

31-83 Albert M. Spooner, Civil Engineer, Grade #3, Bureau of Streets, R-711, City Hall.

32-83 McCreery J. Slack, 3038 W. Addison St., attending Illinois Institute of Technology.

33-83 Fred S. Anderson, Dial Equipment Engineer, Illinois Bell Telephone Company, 208 W. Washington St.

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Figure 8

Figure 8 shows the power station located right in the town of Fribourg, Switzerland. Since this plant is so close to the center of the town, it was given an architectural treatment in keeping with its surroundings.

Figure 9

Bagnell Dam and Power plant on the Osage River in Missouri is shown in Figure 9. This illustrates a conventional concrete gravity type dam coupled with an "outdoor" type powerhouse. In mild climates, this design of powerhouse is economical in that it eliminates the entire superstructure. Note the gantry crane for service to the units.

UNUSUAL HYDRO DEVELOPMENTS

Any discussion of hydro power tends to concentrate on hydroelectric developments. But this is not the whole picture. Water can work for man in other ways. An ingenius invention of a Professor Frizell is a hydraulic air compressor with no moving parts. Several have been used with success since 1885, in Connecticut, Michigan, British Columbia, and Quebec. This compressor works by trapping air with water as it flows down a pipe. This air is tapped off into a plenum chamber at the lowest part of the pipe, and the water allowed to flow on down the river. Because of the constant temperature of the water, this is an "isothermal" compression. Thermo-dynamically, isothermal is the most efficient type of compression, and also results in drier compressed air than other forms of compression. At one of these early installations, the air was fed to a Corliss Engine, and an overall efficiency of 87.5% as obtained. Few hydroelectric plants beat this today!

In 1924, an American engineer invented a new type of turbine-generator which made possible a much smaller plant which would yield the same power. The simplicity and economy of the cross section are marked. This type of power station is possible because a combination turbine-generator is employed in place of two separate units joined by a shaft as is customary. Now, although this turbine-generator (stream-flow generator) was invented in the U.S., it was only developed in Germany by the efforts of a German engineer-politician named Arno Fischer. Through Mr. Fischer's Nazi connections, he was able to have the German Government build twelve of these plants starting in 1936. These plants (called "underwater power plants") did conserve material, but their operation has not been very successful otherwise. None have been built since the war.

Another novel development in the hydroelectric field is the "underground" type of powerhouse. This type has existed in Sweden since 1912. By tunnelling shafts through rock to conduct water to and from an underground power chamber, considerable savings can sometimes be made in a development. This is because of the falling cost of tunnelling and the rising cost of steel penstocks and powerhouse structures.

The largest of existing underground power stations is the Interkirken Development in Switzerland.

That completes the major types of hydro developments.

SUMMARY

In summary, I wish to mention the general topics covered in this paper.

First, I tried to indicate the general position of hydro power in the world today. North America and Europe lead other continents in development, though each has only about 44% of its potential developed.

Then I gave a brief history of the development of hydro power. Power concentrated in a single plant has increased 5,000 times in the last 125 years.

Next, I described the types of water wheels which are the primary element in getting useful power from water.

After this, I described the various types of dams which raise and store water for use in power generation.

Finally, I indicated the various schemes by which the previously described elements are combined to create power. The most recent schemes involve "under water" and "underground" plants, and effect great savings in labor and materials.

In conclusion, I wish to say that the more water we have working for us, the easier our other tasks will be!

Charles Comfort Whittier Memoirs

Charles Comfort Whittier was born in Somerset County, Maine, December 10, 1876. He graduated as a civil engineer from the University of Maine in 1899. In the two years following he served the Maintenance of Way Departments of the Boston & Maine Railroad at Boston, and the Southwestern Railroad of Arizona at Bisbee. In 1901 he entered the employ of Robert W. Hunt Company, Engineers, as civil, mining and metallurgical engineer and remained with that company through May 1933.

Important special assignments included: Chief Engineer and Assistant General Manager of the Ziegler Coal Company, Ziegler, Illinois 1904-07; General Manager of Robert W. Hunt Company, Ltd., Montreal 1913-15; Chief Engineer and Managing Director of various zinc and lead properties directed by the Hunt Company from 1915-23. In the period from 1923-33 he was consulting engineer with Robert W. Hunt Company, assigned to various commissions of developing mineral and other production problems of various clients.

Mr. Whittier's tireless energy and boundless enthusiasm carried him far. His direct and constructive activity contributed much to many important developments in the use and processing of engineering materials. His pleasing personality and dry humor endeared him to his associates.

Mr. Whittier never had any athletic tendencies. His sole hobbies were books and study and, blessed with a tireless energy, he pursued his studies constantly. These studies were not limited to strictly engineering matters.

In June 1933 he left the Hunt Company and became interested in Nutrition Research Laboratories as a partner in the development of vitamins.

Mr. Whittier was interested in all minerals and became interested in vitamins because, as he said, they helped to keep in order "the mineral industry of the human body." This was at about the time when Vitamin "D" was found to have a curative effective upon rickets and arthritis but the Vitamin "D" as manufactured seemed to have poisonous by-products that prevented its use in sufficient quantities to assure hope for the victims of arthritis. Like other experimenters, Mr. Whittier used the organic chemical, ergosterol. But instead of irradiating it with ultraviolet light, the orthodox way, he electrically activated the ergosterol vapor. By that new invention he turned out a product to which he gave the trade name "Ertron" which was largely devoid of the poisonous by-products that had alarmed the medical profession.

This first efficient corrective treatment for arthritis rested in Charles Comfort Whittier's patents, which represented a distinct contribution of the engineering profession to the medical profession. As a monument to his memory the Whittier Laboratories, a nutrition research laboratory located in Chicago, carry his name.

Mr. Whittier retired to California in October 1946 and, even up to the day of his death, was at work on the development of further improvements in vitamins as well as other food products.

The valuable output of Mr. Whittier's dynamic personality and boundless energy are recognized everywhere. He was a member of the Engineering Institute of Canada; American Institute of Mining & Metallurgical Engineers (director 1932-35); Western Society of Engineers (president 1934-35); and the Chicago Engineers' Club (president 1933).

Prepared by

W. W. DeBerard

H. B. Gear

L. R. Howson

H. H. Morgan

Time Study Clinic Oct. 31

The Fifth Annual National Time and Motion Study Clinic, sponsored by the Industrial Management Society, will take place on October 31, November 1 and 2, with headquarters at the Sheraton Hotel.

The Clinic will stress newest developments in methods, layout, handling, time study, motion economy, incentives, humanics, and maintenance.

A feature new to the Clinic will be the Special Achievement Awards to companies and individuals who describe their outstanding achievements in the field of methods improvement. The achievements will be explained by using 16MM movies, slides and actual demonstrations of the "before" and "after" phases of each improvement, plus a brief explanation.

Of interest will be the appearance of Dr. Lillian M. Gilbreth, "Mother" of Motion Study, and heroine of the books, "Cheaper by the Dozen" and "Belles on Their Toes."

Further information on the Clinic may be secured from the Industrial Management Society, 35 East Wacker Drive.

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(*Continued from Page* 14)

mentally or physically for military service. This will provide an annual flow into the pool of available manpower about 864,000, subtracting 74,000 to supply the careerists mentioned above leaves a supply in the pool annually of about 790,000. This, therefore, is the number which must maintain the military establishment of 2,750,000 on a rotational basis. Table II presents the calculation of the relationship of the average length of service and the supply of personnel. It will be noted from this Table that for this situation which will probably be very close to reality sometime between the summer of 1952 and the summer of 1953 it will be necessary to require 3½ years of service of each one.

Table II

Annual increment needed, in addition to those choosing the services as a career, to maintain the strength of the Active Armed Forces at 3,500,000 men:

(a) Average period of service	(b) Annual Requirement	(c) % of whole age group reaching maturity	(d) % of avail. fit expectancy from each age group
2 years	1,375,000	122.0	174.0
3 "	917,000	81.5	116.0
4 "	687,500	61.0	87.0
5 "	550,000	48.0	69.0
6 "	487,000	43.0	61.0

This table is based on the assumption that 750,000 "careerists" are now in the armed services for an average career of 10 years, and that this represents a probable maximum to be maintained. Other assumptions as in Table I.

It is this calculation which indicates clearly that the manpower planning which has taken place up to the present time is completely inadequate and unrealistic and does not provide a basis for the maintenance of the armed strength which the Department of Defense has indicated as essential.

It is the close scrutiny of these figures which led the Institute of Manpower Utilization and Government Personnel, held at Stanford University, August 22, 1951, to declare as follows:

"Assuming that military requirements necessitate the maintenance of an armed establishment of 3.5 million men, it is our opinion that this cannot be accomplished within the present statutory requirements and administrative policies. Moreover, it is essential that present statutes and policies be further amended to insure that an adequate proportion of the number coming of age each year be selected for training in the sciences, professions, and skilled crafts so as to be available for specialized service where most needed in the military forces or in civilian employment after their training is terminated."

The implications of a situation which can give rise to the above arresting statement are many and most significant. It is clear in the first place that regardless of what changes in statutory requirements in Federal policies may arise as a result of re-evaluations of the situation there will inevitably be a sharp competition for the same limited manpower pool by the needs of the military establishment, the needs of the nation for flow of trained personnel, and other needs usually closely related to the national security both now and in the future. Obviously, some re-evaluation must occur and will no doubt take place when the extent of the manpower stringency is sufficiently realized. Such a re-evaluation may result in sharp, questioning by the Congress of the target totals of manpower for the military establishment. It does not appear likely, however, that substantial change in this number will occur. Unquestionably, the length of service will again come under scrutiny with a possibility of an extension of the present statutory limit of 24 months to a longer period. It seems most likely, however, that the Congress will not extend this by statutory alteration but will give to the President the authority to extend it by Executive Order if necessary. Again it seems likely that increased consideration will be given to the removal of exemptions for persons over 19 for reasons of prior service or limited disability. There will be a greater effort, unquestionably, to utilize marginally qualified personnel, and additional consideration to the appropriate uses of women power will no doubt be given. But the larger implication in this whole situation is that the needs of the nation for specialized personnel of both the professional college and university trained grade and the sub-professional or skilled craft category will be inadequately provided for as a result of the effort.

(*Continued on Page* 29)

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Reviews of Technical Books

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Communications

Communication Networks and Lines, by Walter J. Creamer, Harper and Brothers, New York, N. Y., First edition, 1951. 353 pages. $6.00.

This book brings together a large body of material dealing with the mathematical treatment of communication networks and lines. It is designed as a text book for colleges, for Army Signal Corps training courses, and for the practicing communication engineer.

Part One deals entirely with networks, covering network analysis and problems in the design of attenuators, filters, and equalizers, as well as some elementary problems in network synthesis.

Part Two presents the theory of communication lines, with application to cables and open-wire circuits at audio and carrier frequencies.

The subject matter is well organized and logically developed. Liberal use is made of examples and typical problems.

There are eight appendices which provide pertinent formulas, charts, and tables, and a comprehensive index.

H.P.H., W.S.E.

Electrical Circuits

Electric Circuits for Engineers, by Edward K. Kraybill. Published 1951 by the MacMillan Co., New York. 212 pages, $3.85.

This is another of the survey type of text books designed to give non-electrical engineering students a background in the principles of electrical engineering.

The subject is presented as a physical phenomenon in which effect equals cause divided by opposition and this theme is adhered to throughout the book. Under the heading of "causes," electromotive force and its sources in practice are treated. Under "opposition" are grouped the discussions of resistance, inductance, capacity and reactance; and under "effect" the resulting current flow and the usual mathematical methods for evaluation.

Finally, applications in the form of circuits, power and energy, networks and polyphase circuits are tied in with the theme of cause, opposition and effect.

W.F.L., W.S.E.

Water Treatment

Water Treatment, by Eskel Nordell, Reinhold Publishing Corporation, New York, N. Y., First edition, 1951. 526 pages, $10.00.

This book should prove helpful to executives, consultants, engineers, chemists, operating personnel, and students who are interested in the basic principles involved and in the solution of specific problems relative to the treatment of water for industrial and domestic uses.

The author, a chemist by training, brings to this book over thirty-two years experience in laboratory, office and plant. He writes with authority about the water problems in many fields such as ceramics, plastics, rubber, dairy, textile, oil and gas, brewery, pulp and paper, laundry, and municipal.

Subject matters dealt with in the book include: water supplies, dissolved and suspended impurities, boiler feed water, cooling water, aeration, deaeration, chemical feeders, filtration processes, cation-exchangers, etc. Each chapter ends with a bibliography to assist the reader who wishes to make a thorough search of the literature.

The appendix is devoted to stoichiometrical and mensurational tables, conversion factors, flow tables, and power requirements.

H.P.H., W.S.E.

Electric and Magnetic Fields

Principles of Electric and Magnetic Fields, by Warren R. Boast. Published 1948 by Harper & Brothers, New York. 405 pages, $4.75.

This book is a text for undergraduate students. It covers static electric and magnetic phenomena mathematically for a variety of boundary configurations. At appropriate points, practical examples of applications to instruments and equipment are interposed.

Rationalized MKS units are used, based on a time-length-force-charge dimensional system. Otherwise, the business of units is relegated to a secondary place. A tabulated list of units, conversion factors and dimensions of quantities is included in the appendices.

The latter part of the book discusses graphic construction and mapping of flux, and the subjects of permanent magnets and DC transients.

W.F.L., W.S.E.

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PETROLEUM ENGINEER, B.S. 28. Eight mos. trouble shooting television repair. Research and development. Three months testing oil wells, petroleum producers. Five mos. sampler working faces of drifts, copper ore producers; nine mos. salesman—auto insurance. $3800. Midwest. 187-MW.

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RESEARCH-DESIGNER. M.E. Age: 35-55. 3 plus years exp. in heavy machine design and development; may consider experience in light equipment. Must be citizen and able to pass F.B.I. clearance. Knowledge of theoretical mechanics should be strong. Duties: Development and research on mechanical products. Company may help on fee. Business Research. Salary: up to $8500 year. Location: Chicago. R-8132 (a).

MECHANICAL LABORATORY TEST ENGINEER. Age: up to 40. Experience in Army ordnance work helpful with laboratory experience. Knowledge of hand tools and mechanical principles. Duties: Testing mechanical products. Must be a citizen and able to pass F.B.I. clearance. Company may help on fee. Type of business: Research. Salary: up to $400 month. Location: Chicago. R-8132 (b).

DESIGNER-ELECTRICAL. Age: Up to 40. 3 plus years experience laying out industrial electrical work, power, lighting, and controls. Knowledge of circuits and able to do board work. Duties: Laying out and designing industrial systems. Company will pay fee. Salary: $3.00-$3.50 per hour. Location: Chicago. R-8148.

(*Continued from Page* 26)

It is of course obvious that the selection of any considerable number of persons for specialized training, and later service outside military establishment necessarily will increase the average length of service of those who enter military service. While a requirement that persons so selected for specialized training shall spend some minimum time in training may be desirable for its effects on public reaction, it can have nothing but an adverse affect on the military manpower problem because it would require military training facilities for these persons and the corresponding staff to provide the necessary personnel required by the high technological level of our civilization and present military methods. It can only result in a serious deficiency in our eventual ability to meet the challenges the future is certain to hold. With this in mind it may be of importance at this time to examine the flow of personnel in training in those areas of competence of immediate importance in the military operations. What these areas are in modern conflict is difficult at this time to state. Obviously, all practical branches of engineering are included. There are practically no branches of science which are either not identified already as of military importance, or have a fairly clear and discernible probability of being important in the future. However, other areas are similarly to be identified particularly in view of the present conflict with its important ideological overtones. The category of strategically important disciplines is unusually inclusive, in the social sciences, in the humanities, as well as in the technical fields. Nevertheless, for the purposes of this article, we shall confine our attention to engineering and science in view of the specialized interest of this group.

An examination of the engineering situation discloses, in the first place, a remarkable increase in the demands for personnel not only because of the needs of re-mobilization, but also because of the sharply increasing demands on the civilian economy aside from the military requirements. The dimensions of the civilian demand already were beginning to be clear as early as June of 1950 prior to the outbreak of the Korean incident. Every major military conflict in the past has resulted in increasing the tempo of technological demands in the post war civilian economy. This was clear after World War I and was especially significant in the field of Chemistry although in the field of Engineering the phenomenon was also marked. After World War II the effect was especially marked in engineering and physics although marked also in a number of other fields such as chemistry and the biological sciences. The extent of this increased tempo, however, was best measured by the rate of absorption of the extraordinarily heavy enlistments and consequent graduations in engineering in 1949 and 1950. In spite of widespread predictions of unemployment among engineers because of the unprecedented numbers graduating in 1950, surveys conducted by the Engineering Manpower Commission of Engineers Joint Council in June of 1951 showed such a substantial percentage of June graduates who had already been employed that it was then obvious that the predicted unemployment would not exist. The advent of the Korean incident and the consequent involvement of the United States in military action promptly stepped up the demand for engineers to a level far beyond any previous experience in this or any other country. Surveys conducted the past summer indicated the existence of unfilled budgeted openings prior to June in the neighborhood of 70,000 to 80,000 positions. While there is, in such an effort to secure information, the necessary band of uncertainty, it would appear unlikely that this demand was not at least of the order of 60,000 and may have been even above the figure quoted above. Even this figure is so far above the available supply during the past summer as to indicate severe shortages necessarily affecting the ability of the country to meet its production goals. This is because the number of engineering graduates available to fill these demands was only of the order of 35,000, of whom approximately half were already committed to military service and therefore not available for industry because of membership in the military reserve or because of other military liabilities.

While this situation is arresting, it is by no means as alarming as examining future trends in the production of engineers. Present enlistments in engineering schools indicate that the successive graduating classes over the next several years will sharply and progressively reduce. The graduation class expected of June 1952 will be of the order of 25,000 to 27,000 assuming there is no interference from Selectice Service withdrawals. The following year, the maximum possible graduating class will still further have reduced to approximately 22,000. The following year this number will have reduced to about 17,000. While enrollments for the fall of 1951 cannot be quite so accurate, it is probable from information already available that the maximum enrollment will be of the order of the freshman enrollment of 1950, and therefore the graduating class of 1955 will also only be about 17,000. This is the face of a demand which can only be estimated at present as somewhere be-

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(*Continued from Page* 29)

tween two and four times this rate of graduation even assuming that there will be no withdrawals for military purposes.

The situation in the sciences is roughly comparable. While available statistics are not as satisfactory for accurate prediction, discernable trends are very similar. The non-technical demand for scientists at the present time is approximately the same percentage-wise as that of engineers, indicating an unfilled demand for scientists at the present time which must be of the order of from 20,000 to 30,000. Unlike engineering, however, it is clear that the greater the demand, the more extended the preparation and training of the category. The shortage of scientists is most acute at the level of research directors, project directors, group leaders, and independent research personnel.

Paralleled to the situation in engineering is the fact that the graduation of scientists in the coming years will also progressively decrease. The extent of this can only be estimated at present on the assumption that the percentage of persons graduating at the bachelor level in the forthcoming years in the field of science is the same as it has been over previous prewar years.

Male enrollments in colleges have progressively decreased as the following table will show where the graduates beyond 1951 have been estimated from present enrollments and known rates of attrition.

Table III

Graduating classes—1950-54

Class:	Male	Female
1950	330,000	104,000
1951	274,000	84,500
1952	198,000	90,000
1953	180,300	96,000
1954	148,000	98,000

Applying to these figures the customary percentages to indicate the number achieving their bachelor's degree to the sciences exclusive of engineering, the following figures arise:

Table IV

Graduates in the Sciences to the Bachelor's Level

Class	Male	Female	Total
1950	68,000	6,970	75,000
1951	41,200	5,700	47,000
1952	29,700	6,000	36,000
1953	27,000	6,500	33,500
1954	22,200	6,600	29,000

These figures are probably on the long side since every indication which has become apparent in the past two or three years reflects a reducing interest in the sciences and engineering on the part of entering college freshmen. The probability is that the number quoted above, therefore, represents a larger number than those who will graduate with a bachelor's degree in their field. Again, it must be emphasized that these figures are given independent of any effects produced by withdrawals for miltary service. Since some interference is practically certain the numbers must be still further reduced.

It is apparent from what has been said so far that the situation is one warranting grave concern. The major outline of this story seems incontrovertable. The demand for military manpower is certain to be so great as to constitute a substantial interference with training in science and technology. Because of the extraordinarily strategic importance, even in the military sense, of training in the sciences and technology this must be considered serious. Added to this is the fact that there exists even at the present time a sharp deficit between the supply of such personnel available and the demand for them by activities related to national security and becomes even more clearly arresting.

Federal Agencies Slow to Recognize Manpower Crisis

To meet situations of this kind, extraordinary effort will be called for in the direction of national policy and Federal procedure. So far the Federal Government has been exceedingly slow to recognize that manpower will probably be the most critical problem in the nation and will therefore require the most careful attention by appropriately constructed Federal Agencies. Only recently has there been in the Federal Government an agency with primary responsibility for manpower. Prior to this the most important manpower decisions in the Government were made by indirection. For example, the size of the military establishment was a manpower decision; the establishment of production goals had highly important manpower implications; even allocation of scarce materials or other acts of control by agencies of the Federal Government necessarily created specific manpower demands and affect the pattern of manpower distribution. Each of these acts created the need for more manhours of labor in certain areas and may have created reductions in manpower demands in others. Heretofore, there has been wholly inadequate attention given to whether such supplies of personnel exist, or whether the demands upon them have been adequately phased so as to avoid rapidly fluctuating demands.

Policy Committee Established

Recently there has been established a National Manpower Policy Committee and an advisory Committee on Specialized Personnel in the Office of Defense Mobilization. These instrumentalities make possible an approach to these problems but whether these mechanizations are adequate or not can only be determined in the course of time. The problems are so serious that more powerful instrumentalities may be necessary. In the meantime, however, it should be noted that manpower is not a commodity as impersonally dealt with as aluminum, copper, and water power. There is an unusually important role for the independent organizations of such specialized personnel as are represented by the group meeting here today. Manpower is, after all, made up of people and these people have individualities, personal attributes, likes and dislikes and peculiarly human needs. Engineers and scientists, while no different from other people, do, because of the nature of their work, present special problems in their proper allocation. It is doubtful if the proper solution to the problems of manpower utilization can be reached without the continued cooperation of leadership representing the organizations of professional personnel. If the problem is to be satisfactorily met, there must be a flow of information, a flow of informative opinion and a mechanism for assistance—all of them reaching the grassroots level. It my firm conviction that the satisfactory solution to this plan is more likely if the many engineering and scientific societies throughout the nation are wholly alert to it and appropriately organized to assist in arriving at satisfactory solutions and at implementing decisions which may have to be made.

Crerar Library

Notes and News

A complete set of the specifications of patents issued by the French government, 1866-1943, is one of the most important gifts received by the Library in recent months. Also included, is the French equivalent of our Patent Office Gazette, covering the years 1866 to date. No other set of these basic patent records is located in the Midwest. The total collection, approximately 2,500 volumes, will be stored temporarily in the Midwest Inter-Library Center on Cottage Grove Avenue. When reorganization of Crerar's book stacks has been completed, the French patents will be transferred from the Center and made available for public use.

* * *

Reorganization of the reference service in the Technology Department has been in progress for many months. Announcements have been made in earlier issues of this column, concerning improvements in arrangement of the current periodicals and abstracting publications. It is now possible to relocate the catalogs and reference desk, changes which have long been in prospect. It is hoped that these changes will result in improved service to researchers and students in at least two ways—first by offering better service in the use of the catalogs, and second by reducing the number of interruptions of conferences at the reference desk between technology librarians and readers. Comments on these changes, and suggestions in general for the improvement of the Library's services, will be welcomed from all engineers.

* * *

Some of the small number of books "lost" from the Library find their way back. One of the most surprising prodigals in the records is a two volume edition of a Portuguese-English dictionary. This was recently sent to the Library by the Chicago Post Office, unwrapped, where it had been found and identified from the book plates. Our records disclosed that the work had been missing since 1914. To illustrate how patiently we wait—the work was finally given up as lost, and the records were withdrawn, in 1933.

Obituaries

Walter A. Shaw, a member of the WSE since October, 1900, and a Life Member since 1938, died on September 4 of this year. He was 83 years old.

A well known consulting engineer, Mr. Shaw was active in his profession until 1947, when he retired.

Posts he held were: Member of the reorganization committee for the Chicago Rapid Transit Company; Special adviser on reorganization of the Chicago Surface Lines; Chairman of the joint board of management and, in 1942, he was placed in charge of operations.

On August 25 **Frank V. Carroll,** 63, one of the most widely known steel engineers in the country, died in his home at Munster, Indiana.

Mr. Carroll was Chief Engineer of the Inland Steel Company at the time of his death. During his thirty years with Inland, the company increased its annual production from 1,750,000 to 3,400,000 tons.

He began his career as a draftsman in the Joliet works of the Illinois Steel Co. in 1905 and subsequently was employed by National Tube, Gary Tube, U. S. Ordnance, and Youngstown Sheet and Tube Company.

Mr. Carroll became a member of the WSE on October 17, 1949.

J. E. Flanagan, President of the Post Electric Company, and a member of the W. S. E. since 1936, died October 7, 1950. He was a recognized authority on electrical construction.

Frederick W. Shaw. After a short illness, Mr. Shaw died November 15, 1950, and had been a member of W. S. E. since July, 1920. Mr. Shaw was a graduate of the University of Illinois in civil engineering, and was a registered structural engineer engaged in private practice for several years.

Raymond Lewis, identified with the Mechanical Section, died on August 19. He was Superintendent of Engineering and Maintenance of the American Steel & Wire Company of Waukegan, Ill. He was a graduate of Armour Institute and joined WSE in 1946.

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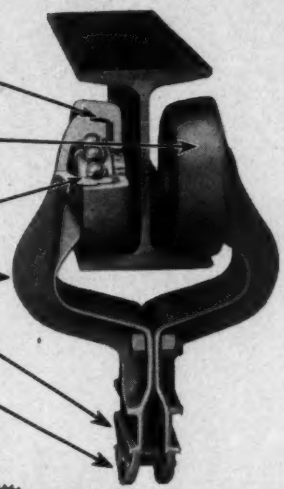

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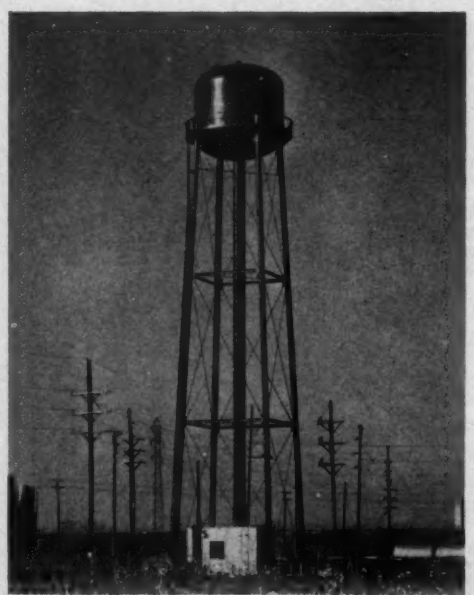

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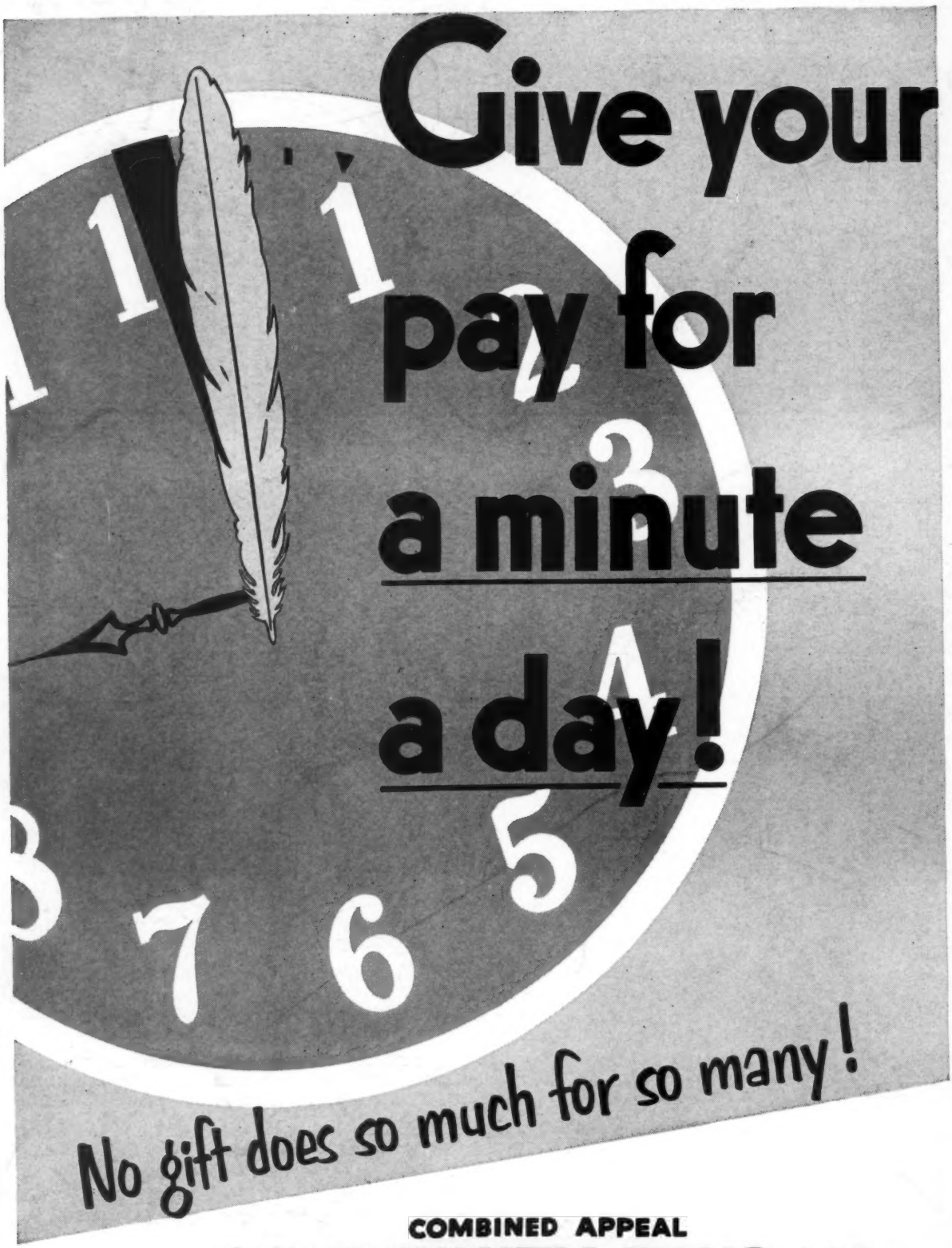

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